Letter Health Consultation

Indoor Air Quality Assessment from Hidden Springs Charter School Campus Boise, Idaho

July 18, 2013

Prepared by

Idaho Department of Health and Welfare
Division of Public Health
Bureau of Community and Environmental Health
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July 18, 2013

Mr. Mike Stilton 4112 W. Deer Path Dr. Boise, ID, 83714

RE: Health Consultation

Indoor Air Quality Assessment-Hidden Springs Charter School, Boise, Idaho

Dear Mr. Stilton:

This letter has been prepared as a consultation to evaluate human health impacts from indoor air contaminants at Hidden Springs Charter School Campus, Boise, Idaho. The Idaho Department of Health and Welfare's priority is to ensure Idahoans have the best information possible to safeguard their health.

Background and Statement of Issues

In October 2011 Industrial Hygiene Resources (IHR) of Boise, Idaho performed an indoor evaluation at Hidden Springs Charter School Campus, Boise, Idaho to document the presence of common air contaminants present in the buildings (Industrial Hygine Resources, 2011). This assessment was prepared in response to concerns of some employees regarding air quality and health issues. In June 2013, Mr. Stilton, a parent at the school, requested that the Bureau of Community and Environmental Health (BCEH) evaluate data presented in the 2011 IHR report to determine whether volatile organic compounds detected in indoor air pose a public health threat to students and workers at Hidden Springs Charter School. The purpose of this letter health consultation (LHC) is to review the IHR evaluation data and to provide relevant public health conclusions and recommendations.

Five indoor air quality parameters were evaluated: mold spores counts, total volatile organic compounds (VOCs), formaldehyde, 4-phenylcyclorohexane, and carbon monoxide. This letter health consultation will evaluate the health impacts of exposure to the pollutants that were detected in indoor air. The exposures that will be considered in this health consultation will include exposure to people using the buildings during the school year.

Results and Discussion

In October 2011, IHR collected a total of 15 samples for each indoor air chemical from 4 buildings at the Hidden Springs Charter School Campus. In addition, IHR collected two outside ambient air samples for mold and one for each of the other indoor air contaminants. According to IHR, air sampling was performed under normal working conditions and times in the buildings, spanning roughly six hours in five representative locations in the office space. The mold spore air samples were collected on Versa Trap filter cassettes at a sampling rate of 15 liters of air per minute. Formaldehyde, total VOCs, and 4-phenylcyclorohexane were collected on passive badges and all samples were analyzed by Assay Technologies (AT) Laboratory. Total VOCs and 4-phenylcyclohexene were analyzed using Wisconsin Occupational Health Lab methods (WG006 or WG030), based on OSHA method number 7. Formaldehyde was analyzed using method WG036, based on OSHA method number 52. Gas chromatography equipped with flame ionizing detector was used for the analysis of total VOCs and 4-phenylcyclohexene. Q-Trak indoor air quality monitor was used to confirm indoor air concentrations of carbon monoxide.

Concentrations of mold spores found in sampling locations ranged from 13 fungal structures per cubic meter (structures/m³) in Room 030 (Building 100–Administration) to 280 fungal structures/m³ in the gym stage. Currently, there is not a human health threshold for mold present in indoor air. However, a recent publication mentions a reference value of less than or equal to 380 counts (or structures) per cubic meter (cts/m³) for the determination of baseline condition of a building under normal condition for the general acceptability of indoor environmental quality (Sahay, Aguirre, & Wazinan, 2006). If we consider 380 cts/m³ as a reference to evaluate the results, the highest count at the gym stage (280 cts/m³) is below the reference value found in the cited study. No health based information is applied to the levels in the study; thus, they cannot be used to determine if health effects might occur at different levels. However, it is interesting to note that the numbers of airborne-fungi in all the rooms tested were within the relatively low concentration reported in this study (less than 100 cts/m³ to 300 cts/m³).

Results of the indoor and ambient air sampling included: total VOCs, formaldehyde, 4-phenylcyclorohexane, and carbon monoxide. VOCs comprise a wide variety of gases emitted from solids or liquids. Some may pose adverse short or long term health effects to those exposed. IHR used a worst case scenario by assuming all the VOCs measured were hexane. Hexane is used as cleaning agent in many industries, including the printing, textile, furniture, and shoemaking industries. Certain kinds of special glues used in the roofing and the shoe and leather industries, and gasoline also contain hexane (ATSDR, 1999). Hexane was the only one of 16 solvents tested which caused no irritation to the eyes, nose, or throat at the highest concentration tested [500,000 parts per billion (ppb)] (ATSDR, 1999).

Total VOC values ranged from 5.1 ppb in the gym stage to 230 ppb in Room 030 (Building 100–Administration) and Room 210 (Building 200–Classroom). If we were to assume that the total quantity of VOCs is all hexane, the most toxic of the VOCs measured, even at the highest value of 230 ppm, this level is below the Agency for Toxic Substances and Disease Registry (ATSDR) human health comparison value for chronic exposure (> 360 days) to hexane of 600 ppb. Based on these results, BCEH does not expect that the VOCs would have any harmful health effects on the students or staff at Hidden Springs Charter School.

Formaldehyde is a colorless, flammable gas at room temperature. It has a distinct odor and it is irritating to tissues when it comes into direct contact with them. Some people are more sensitive to the effects of formaldehyde than others. It causes a burning sensation in the eyes, nose and lungs at high concentrations (ATSDR, 1999). Formaldehyde is produced in small amounts in our bodies as part of metabolism and it can be measured in the urine (ATSDR, 1999). In general, exposure to formaldehyde is higher indoors than outdoors because of the lower air exchanges indoors. Major sources of formaldehyde in the indoor environment include wood-based materials, insulation materials, coating materials, flooring materials, cork products, combustion materials (cigarette smoking, wood burning, burning of incense mosquito coils and candles) (Salthammer, Mentese, & Marutzky, 2010). Formaldehyde is also present in household products such as carpet cleaners, disinfectants, cosmetics, medicines, fabric softeners, glues, lacquers, and antiseptics (ATSDR, 1999).

All the formaldehyde sampling results were below the detection limit of the analytical method used. However, the detection limit is higher than the Chronic Reference Dose Media Evaluation Guides (EMEG) and the Cancer Risk Evaluation Guides (CREG) comparison values. Thus, a few assumptions were made below in determining if the formaldehyde levels present a long-term health risk to those attending or working at the school. Formaldehyde concentration ranges, average and comparison values (CVs) are presented in Table 1. The analytical results show that samples from the school range from less than 15 ppb in offices (Building 100–Administration) and Room 114 (Building 300–Classroom) to less than19 ppb in the gym stage. Assuming that the maximum value was one-half of 19 ppb or 9.5 ppb, this value is below the acute noncancer screening level (40 ppb). Assuming that the average concentration was one-half of 16 ppb or 8 ppb, this value is similar to the chronic noncancer screening level (8 ppb) and above the cancer screening level (0.063 ppb). The assumed average value of 8 ppb is below the California target level for formaldehyde in indoor air of 50 ppb (ALARA = as low as reasonably achievable) (California Air Resources Board, 1991) and below the reported formaldehyde level inside classrooms in California (estimated average of 18 ppb) (California Air Resources Board, 2005).

Table 1. Indoor Air Data and Comparison Values for Formaldehyde at Hidden Springs Charter School

Indoor Air Contaminant	Concentration Range ^a	Average	ATSDR Comparison Values in ppb
Formaldehyde (ppb)	less than 15 – less than 19	less than 16	40 ^b 8 ^c
			$0.063^{ m d}$

a = Laboratory method detection limit

A recent review suggests the positive association between formaldehyde levels and asthma in children (McGwin Jr., Lienert, & Kennedy Jr., 2011). Another study found formaldehyde levels in homes to be significantly associated with hospitalizations for asthma in children aged six months to three years. No effects were found in children exposed to levels of 22 ppb, wheeze was present at 33 ppb; asthma, running nose and hay fever were reported at formaldehyde levels of 26 ppb (Rumchev, Spickett, Bulsara, Phillips, & Stick, 2002). Thus, children, particularly

 $b = ATSDR \ Acute \ Reference \ Dose \ Media \ Evaluation \ Guides \ (EMEG)$

c = ATSDR Chronic Reference Dose Media Evaluation Guides (EMEG)

d = ATSDR Cancer Risk Evaluation Guides (CREG)

those having asthma might be at greater risk from exposure to formaldehyde in the indoor environment. The maximum and average formaldehyde levels reported in Hidden Springs are below the formaldehyde levels found in studies that trigger some health effects. Although we would not expect any observable adverse health effects at the levels found in the school, BCEH has classified this contaminant as posing an indeterminate public health hazard because it is not known if there may be increased allergic sensitization to common allergens caused by exposure to formaldehyde at these levels. Currently, there is not sufficient medical research to make this determination.

EPA classifies formaldehyde as a probable human carcinogen (ATSDR, 1999). This means that exposure to this compound could theoretically increase a person's risk for developing cancer over the course of a lifetime. BCEH estimates the theoretical cancer risks associated with long-term exposure to this contaminant to be low. The risk would be five additional cancers per one million people exposed¹. We would interpret these risks as posing no apparent increased risk for developing cancer over the course of a lifetime. The actual theoretical cancer risks will be lower because, unless new sources are brought into the buildings, formaldehyde levels in newly constructed buildings decreases over time. In addition, BCEH used the highest value (19 ppb) to calculate exposure. This is a conservative (i.e., more protective) approach since it is very likely that the real levels in the school were less than 19 ppb. Thus, BCEH does not expect exposure to formaldehyde indoors at Hidden Spring Campus to result in increases in the risk of developing cancer above what is normally seen in U.S. populations.

ATSDR does not have any human health comparison value for 4-phenylcyclorohexane present in ambient air, so no comparisons can be made; however, all the values were below the Leadership in Energy and Environmental Design (LEED) threshold value of 0.0065 mg/m³. Carbon Monoxide values (< 1 ppm) were below the EPA National Ambient Air Quality Standards (NAAQS) of 9 ppm by volume of carbon monoxide in air averaged over 8 hours and not to be exceeded once a year (EPA, 2012).

Conclusion

BCEH does not expect breathing the air inside Hidden Spring Charter School to result in harm to either children or adults. BCEH concludes this because the levels of formaldehyde detected in indoor air, which are likely to reduce overtime, are comparable to levels found in new buildings and below the levels at which observable adverse health effects have been found. There is some research that shows exposure to formaldehyde in the indoor air can cause people to become sensitive to the chemical and later develop allergic reactions, but, at this time, the scientific literature does not report the levels of exposure at which this sensitization might occur.

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¹ This calculation estimates additional life time cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a lifetime of exposure (ATSDR, 2005). Cancer risk estimates were calculated using EPA's cancer inhalation unit risk estimate of $1.3 \times 10^{-5} \,\mu\text{g/m}^3$, the maximum concentration of 19 ppb (23.3 $\mu\text{g/m}^3$) and exposure durations of eight-hours per day, five days per week, 38 weeks, per year for 6 years. A cancer risk estimate of 5×10^{-6} means that if 1 million people were exposed to this contaminant, eight-hours per day, five days per week, for 6-years, over the course of a 70-year lifetime five of those people could theoretically get cancer from that exposure.

Recommendations

- If symptoms, such as eye irritation, are still being reported, it would be advisable to use other measuring techniques to identify specific VOCs that might me causing the "new carpet-like odor and eye irritation" symptoms mentioned in the report. VOCs that are commonly present in indoor school environments and that have human health comparison values include, but are not limited to: toluene, xylenes, acetaldehyde, hexane, benzene, and acetone.
- The presence of VOCs in indoor environments depends upon several factors such as humidity, temperature, and air flow. To minimize exposures of VOCs to children it would advisable to: 1) include a routine maintenance of HVAC systems (e.g., periodic cleaning or replacement of filters, replacement of water-stained ceiling tile; 2) operate the HVAC system to at least its design standard, and to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 62-2001 if possible; 3) vent contaminant source emissions to the outdoors; 4) store and use paints, adhesives, solvents, and pesticides in well ventilated areas; 5) use these pollutant sources during periods of non-occupancy, and 6) purchase and use low-VOC materials or allow time for building materials in new or remodeled areas to off-gas pollutants before occupancy.
- Education and communication play key roles in solving indoor air quality issues. Building occupants, management, maintenance personnel, and parents should fully communicate and understand the causes and consequences of indoor air quality problems so they can work more effectively together to solve and prevent adverse health effects.

If you have any questions, please do not hesitate to contact me at 208-334-5682 or padenn@dhw.idaho.gov

Sincerely,

Norka E. Paden, Ph.D. Toxicologist/Public Health Assessor

cc: Jim Vannoy

References

- ATSDR. (1999). *Toxicological profile for formaldehyde*. Atlanta: US Department of Health and Human Services.
- ATSDR. (1999). *Toxicological Profile for n-Hexane*. Atlanta: US Department of Health and Human Services.
- ATSDR. (2005). *Public Health Assessment Guidance Manual*. Atlanta: US Department of Health and Human Services.
- California Air Resources Board. (1991). Formaldehyde in the home indoor Air Quality Guide. Sacramento: Research Division.
- California Air Resources Board. (2005). *Indoor Air Pollution in California*. Keeley.
- EPA. (2012). *Air and Radiation*. Retrieved from National Ambient Water Quality Standars: http://www.epa.gov/air/criteria.html
- Industrial Hygine Resources. (2011). Report of the Indoor Air Quality Assessment: Four Buildings on the Hidden Springs Charter School Campus 5480 West Hidden Drive, Boise. Idaho. Boise.
- McGwin Jr., G., Lienert, J., & Kennedy Jr., J. (2011). Formaldehyde exposure and asthma in children: a sistematic review. *Ciancia & Salude Coletiva*, 16(9), 3845-3851.
- Rumchev, K., Spickett, J., Bulsara, M., Phillips, M., & Stick, S. (2002). Domestic exposure to formaldehyde significantly increases the risk of asthma in young children. *European Respiratory Journal*, 20, 403-408.
- Sahay, A., Aguirre, F., & Wazinan, A. (2006). Airborne Fungal Reference for Buildings Evaluations Established. *IEO Reviews*, 1(242).
- Salthammer, T., Mentese, S., & Marutzky, R. (2010). Forlmaldehyde in the Indoor Environment. *Chemical Reviews*, 110, 2536-2572.